IN THE CLAIMS

1. (currently amended) A designing method of an acoustic matching layer of a piezoelectric transducer including a piezoelectric plate that is an electric device of a ceramic group capable of converting an electric pulse into a sound wave pulse signal, a back absorption layer that is a sound wave absorption layer for preventing an echo phenomenon of the piezoelectric plate, one or more acoustic matching layers formed in a thin layer structure constructed in order that sound waves generated in the piezoelectric plate can be transferred in the direction of a front load, and an electric matching device that is an electric device for matching an external electric equipment and electric impedance, ~~so that the present invention is well adapted to various fields such as medical diagnosis, underwater detection, nondestructive evaluation, etc.,~~ which comprises:

selecting a front load effective impedance when in the direction of load from a front side of the piezoelectric plate as a design parameter; and

determining an impedance characteristic of each acoustic matching layer using the following matching formula shown in the following table of which values are obtained based on the formula of:

$$\ln \frac{Z_{i+1}}{Z_i} = 2^{-n} C_i^n \ln \frac{Z_t}{Z_f^{(0)}}$$

, where i = 0, ...,n, $Z_0 = (Z_f)^{(0)}$, $Z_{n+1} = Z_t$, $C_n^i = \frac{n!}{(n-i)!\,i!}$, and

[Table]

Impedance / Number of layers	Z1	Z2	Z3
1	$((Z_f)^{(0)} (Z_t))^{1/2}$		
2	$(Z_f)^{(0)3/4} (Z_t)^{1/4}$	$(Z_f)^{(0)1/4} (Z_t)^{3/4}$	
3	$(Z_f)^{(0)7/8} (Z_t)^{1/8}$	$(Z_f)^{(0)} (Z_t)^{1/2}$	$(Z_f)^{(0)1/8} (Z_t)^{7/8}$

where Z_f represents an effective impedance of front load viewed from the front side of the piezoelectric plate, and $(Z_f)^{(0)}$ is (Z_f) at the free resonant frequency, and (Z_t) is a front load impedance, and the above results are obtained until n=3.

2. (original) The method of claim 1, wherein when designing the acoustic matching layers of the piezoelectric transducer, a video waveform, not a RF waveform, is used for evaluating sensitivity and pulse width of the piezoelectric transducer.

3. (original) The method of claim 1, wherein an optimized design parameter is determined in a region in which an amplitude in a peak amplitude contour map and a depth in a pulse width contour map are duplicated for optimizing the design parameter.

4. (currently amended) A designing method of an acoustic matching layer of a piezoelectric transducer including a piezoelectric plate that is an electric device of a ceramic group capable of converting an electric pulse into a sound wave pulse signal, a back absorption layer that is a sound wave absorption layer for preventing an echo phenomenon of the piezoelectric plate, one or more acoustic matching layers formed in a thin layer structure constructed in order that sound waves

generated in the piezoelectric plate can be transferred in the direction of a front load, and an electric matching device that is an electric device for matching an external electric equipment and electric impedance, ~~so that the present invention is well adapted to various fields such as medical diagnosis, underwater detection, nondestructive evaluation, etc.,~~ an optimum designing method of matching layers of a thickness-mode piezoelectric transducer, comprising the steps of:

(1) a step in which a certain front load effective impedance is inputted, and a sensitivity, pulse width and performance index of a piezoelectric transducer are computed based on a KLM model computation;

(2) a step in which a minimum value of a front load effective impedance is selected based on a sensitivity, pulse width and performance index of the piezoelectric transducer computed in the step (1);

(3) a step in which a minimum value of the front load effective impedance is inserted into the matching formula shown in the following table obtained based on the following formula; and

(4) a step in which an impedance computed in the step (3) is determined as an impedance of each layer,

[formula]

$$\ln\frac{Z_{i+1}}{Z_i} = 2^{-n} C_i^n \ln\frac{Z_t}{Z_f^{(0)}}$$

where $i = 0, \ldots, n$, $Z_0 = (Z_f)^{(0)}$, $Z_{n+1} = Z_t$, $C_i^n = \frac{n!}{(n-i)!\,i!}$, and

[Table]

Impedance / Number of layers	Z_1	Z_2	Z_3
1	$((Z_f)^{(0)} (Z_t))^{1/2}$		
2	$(Z_f)^{(0)3/4} (Z_t)^{1/4}$	$(Z_f)^{(0)1/4} (Z_t)^{3/4}$	
3	$(Z_f)^{(0)7/8} (Z_t)^{1/8}$	$(Z_f)^{(0)} (Z_t)^{1/2}$	$(Z_f)^{(0)1/8} (Z_t)^{7/8}$

where Z_f represents an effective impedance of front load viewed from the front side of the piezoelectric plate, and $(Z_f)^{(0)}$ is (Z_f) at the free resonant frequency, and (Z_t) is a front load impedance, and the above results are obtained until n=3.

5. (new) In a method of designing a piezoelectric transducer including a piezoelectric plate of a ceramic group for converting an electric pulse into a sound wave pulse signal, a back sound wave absorption layer for preventing an echo phenomenon of the piezoelectric plate, and one to three acoustic matching layers having respective impedances (Z_1, Z_2, Z_3) so that sound waves generated in the piezoelectric plate can be transferred in the direction of a front load, the improvements comprising:

selecting a front load impedance (Z_t) and an effective impedance of the front load (Z_f) viewed from a front side of the piezoelectric plate; and

determining the impedances (Z_1, Z_2, Z_3) of each of the acoustic matching layers using the following matching formula and table:

$$\ln \frac{Z_{i+1}}{Z_i} = 2^{-n} C_i^n \ln \frac{Z_t}{Z_f^{(0)}}$$

, where $i = 0, \ldots, n$, $Z_0 = (Z_f)^{(0)}$, $Z_{n+1} = Z_t$, $C_n^i = \frac{n!}{(n-i)!\,i!}$, and

[Table]

Number of layers \ Impedance	Z_1	Z_2	Z_3
1	$((Z_f)^{(0)} (Z_t))^{1/2}$		
2	$(Z_f)^{(0)3/4} (Z_t)^{1/4}$	$(Z_f)^{(0)1/4} (Z_t)^{3/4}$	
3	$(Z_f)^{(0)7/8} (Z_t)^{1/8}$	$(Z_f)^{(0)} (Z_t)^{1/2}$	$(Z_f)^{(0)1/8} (Z_t)^{7/8}$

where Z_f represents the effective impedance of front load viewed from the front side of the piezoelectric plate, and $(Z_f)^{(0)}$ is (Z_f) at the free resonant frequency, and (Z_t) is the front load impedance, and the above results are obtained until n=3.